Ellipsoidal inclusions in lyotropic nematic liquid crystals

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We experimentally study the behavior of colloidal particles dispersed in nematic liquid crystals (LC). We focus on the influence of the particle shape on their interactions when introduced into the LC matrix. The latter are solutions of rodlike (calamitic phase) or disklike (discotic phase) micelles. Micrometer-sized ellipsoids are prepared by uniaxial mechanical stretching of polystyrene spheres of controllable aspect ratio, k [1]. When embedded into a calamitic nematic solvent, ellipsoids with small enough aspect ratios aggregate one another and form anisotropic structures well-aligned along the local director (as already observed for spheres [2]). This is however no longer the case when k reaches a critical value : above that value, ellipsoids remain surprisingly well-dispersed and apparently do no interact with each other, even over very long periods of time (several weeks). Therefore, there exists a transition from an aggregated to a non-aggregated state as a function of aspect ratio and for a given particle concentration. This behaviour has not been predicted so far [3] and we put forward a simple argument in order to explain this result. Finally, we use a discotic nematic matrix to explore the role of boundary conditions, i.e. anchoring types, and compare our results with those obtained in the calamitic nematic case.

References

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[3] Andrienko et al., PRE (2002) ; F. R. Hung et al., PRE 74, 011711 (2006).